



Learning Objects Initiative

# Dynamic Assembly of Learning Objects

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*IEEE LTTC Workshop on Sequencing  
and Navigation (WoSS&N)*

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# Outline

- Overview
- The Dynamic Learning Experience (DLE) System
- The Dynamic Assembly process
- Pilot Studies and Evaluation
- Learning Content Development for DLE
- Conclusions

# Motivation

- **Adult learners** are highly motivated to educate themselves on new, job-relevant information.
- Instead of taking web-based training courses, these learners ask experts, search databases, and scan through technical documents to **quickly learn what they need to know.**
- However, for learners new to a subject, information is often **difficult to find and organize information for effective learning.** Knowledge acquired is often disconnected, forgotten, or **not effectively integrated into practice.**



# Approach

- **Modularization** – Create or quickly extract learning objects that achieve a focused objective quickly.
- **Dynamic Assembly** – Enable users to dynamically assemble learning objects into short, focused sequences.
- **Customization** – Allow learners to customize these sequences to fit their immediate needs or the needs of others in the context of work, assignments, or other motivating factors.
- **Sharing** – Allow learners and more knowledgeable peers to easily share these sequences (called “custom courses”).



## Benefits

- **Motivation** - *Self-directed learners are often more motivated.* Creating courses to meet their individual needs involves learners in the process and may increase job satisfaction as employees feel both *trusted* and *enabled to learn on the job*.
- **Effectiveness** – Courses created dynamically can be sized to address the *precise learning gap* to the extent that the learner or a team member is aware of the learner's needs.
- **Relevance** – Much of the information in e-learning courses is inapplicable to a given individual. Learners often find it difficult to navigate through and skip the information they don't need. Individualized courses solve this problem by *focusing the learner on a small set of resources* relevant to a given topic.
- **Timeliness** - Users may need access to content before it is found in classroom or online courses designed by professional instructors. This approach provides a *fast way to assemble reference material* authored by subject matter experts, mentors, leaders, or knowledgeable peers.

# Dynamic Learning Experience

Lotus Workplace **Live Showcase**  
brought to you by Lotus Customer Advocacy and Product Introduction (CAPI)

Welcome, Rob Farrell | I am available | January 5, 2005

My Workplace | Lotus Workplace for Business Controls & Reporting | **Dynamic Learning (Tech Preview)**

Dynamic Learning Experience

Home | Course assembly | My courses

Course assembly - Dynamic assembly

Create your Custom Course

**Dynamic assembly** | Manual assembly

Enter topic keywords to assemble a custom course relevant to your learning needs. You may also select how long you would like your custom course to be and how broad its scope should be.

Topics:   [Advanced Search](#) [Reset](#)

Examples: on demand, "on demand" portals, virtualization, +linux -windows

Desired course duration:

Desired depth: ☒ in-depth ☐ overview

[Show Search Help](#)

You can also use [Manual assembly](#) to use Dynamic Learning Experience to search for modules to include in your custom course.

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- a Tech Preview portlet for IBM Lotus Workplace™
- Winner of Brandon Hall “Excellence in Learning” Award for Innovative Technology



<http://www.alphaworks.ibm.com/tech/dle>



# Dynamic Assembly Query and Preferences

@CC Automatic assembly - Microsoft Internet Explorer

File Edit View Favorites Tools Help

Back Forward Stop Search Favorites Media Print W

IBM Custom Course Robert G. Farrell [Sign out](#)

Home | **Course assembly** | My courses | My profile

Assemble course  
Feedback

## Course assembly - Automatic assembly

Create your @Custom Course

Manual assembly Automatic assembly

Enter topic keywords to assemble a custom course relevant to your learning needs. You may also select how long you would like your assembled custom course to be.

Topic:  [Assemble](#)

Ex: J2EE security, "security model", +security model, J2EE -security, -security J2EE "data queues"

Desired course duration:

Desired Search Scope: ☐ indepth ☒ overview

[show advanced query options](#)

You can also use [Manual assembly](#) to use @Custom Course to search for modules to include in your custom course.

CC Page: 0016

Local intranet

# A Sequence of Learning Objects

The screenshot shows a Microsoft Internet Explorer window titled "@CC wsdl - Microsoft Internet Explorer". The address bar shows a local intranet path. The page content is titled "wsdl" and includes a sidebar with links: "Modify course properties", "Discard course", "Share course", and "Feedback". The main content area states: "Here is your custom course with objectives under each lesson. Use the drag icons (⬆️) to move lessons up or down in the lesson order. Press Play Course to begin the first lesson." Below this, a table titled "Course Lessons and Objectives" lists five lessons with their durations and objectives. The total course duration is 33 minutes. At the bottom, there is a "Play course" button and a footer indicating "CC Page: 0004".

Course Lessons and Objectives		Course Duration: 33 minutes
	Title	Duration
⬆️	<b>Lesson 1:</b> <a href="#">Application development methodology</a> [Introduction - Websphere] <ul style="list-style-type: none"> <li>To provide an overview of the methodology that IBM Global Services uses for application development.</li> <li>To show the many considerations that the underlying technology will generate as it relates to application development</li> </ul>	9 min
⬆️	<b>Lesson 2:</b> <a href="#">Creating a Web service client</a> [Procedures - WebSphere Studio] <ul style="list-style-type: none"> <li>create a custom client for the web service</li> </ul>	4 min
⬆️	<b>Lesson 3:</b> <a href="#">Introduction to WSDL</a> [Introduction - Web Services] <ul style="list-style-type: none"> <li>understand the structure and use of the Web Services Description Language (WSDL) document as described in the WSDL 1.1 specification</li> </ul>	17 min
⬆️	<b>Lesson 4:</b> <a href="#">WSDL</a> [Concepts - Web Services] <ul style="list-style-type: none"> <li>Know usage of WSDL</li> </ul>	1 min
⬆️	<b>Lesson 5:</b> <a href="#">Overview</a> [Concepts - Web Services] <ul style="list-style-type: none"> <li>Overview of WSAD tools and their use in different Web services development strategies</li> </ul>	2 min

Course Lessons and Objectives

Course Duration: 33 minutes

[Play course](#)

CC Page: 0004

Local intranet



# Given Different Preferences for the Same Query

@CC Automatic assembly - Microsoft Internet Explorer

File Edit View Favorites Tools Help

Back Forward Stop Home Search Favorites Media

IBM Custom Course Robert G. Farrell Sign out

Home Course assembly My courses My profile

Assemble course  
Feedback

## Course assembly – Automatic assembly

Create your @Custom Course

Manual assembly Automatic assembly

Enter topic keywords to assemble a custom course relevant to your learning needs. You may also select how long you would like your assembled custom course to be.

Topic:

Ex: J2EE security, "security model", +security model, J2EE -security, -security J2EE "data queues"

Desired course duration:

Desired Search Scope: ☒ indepth ☐ overview

[show advanced query options](#)

You can also use [Manual assembly](#) to use @Custom Course to search for modules to include in your custom course.

CC Page: 0016

Local intranet

# A Different Sequence is Generated

@CC wsdl - Microsoft Internet Explorer

File Edit View Favorites Tools Help

Back Forward Stop Home Search Favorites Media Print W

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Home Course assembly My courses My profile

Automatic assembly >

**wsdl**

Here is your custom course with objectives under each lesson. Use the drag icons (⬆) to move lessons up or down in the lesson order. Press Play Course to begin the first lesson.

Course Duration: 20 minutes

Course Lessons and Objectives	
Title	Duration
⬆ Lesson 1: <a href="#">Introduction to WSDL</a> [Introduction - Web Services] <ul style="list-style-type: none"> <li>understand the structure and use of the Web Services Description Language (WSDL) document as described in the WSDL 1.1 specification</li> </ul>	17 min
⬆ Lesson 2: <a href="#">WSDL</a> [Concepts - Web Services] <ul style="list-style-type: none"> <li>Know usage of WSDL</li> </ul>	1 min
⬆ Lesson 3: <a href="#">Overview</a> [Concepts - Web Services] <ul style="list-style-type: none"> <li>Overview of WSAD tools and their use in different Web services development strategies</li> </ul>	2 min

Course Duration: 20 minutes

⬆ Play course

CC Page: 0004

Done Local intranet

# The Dynamic Assembly Problem

## Example:

- Given: a **topic query**  
- AND -  
a set of **preferences**  
and **constraints**

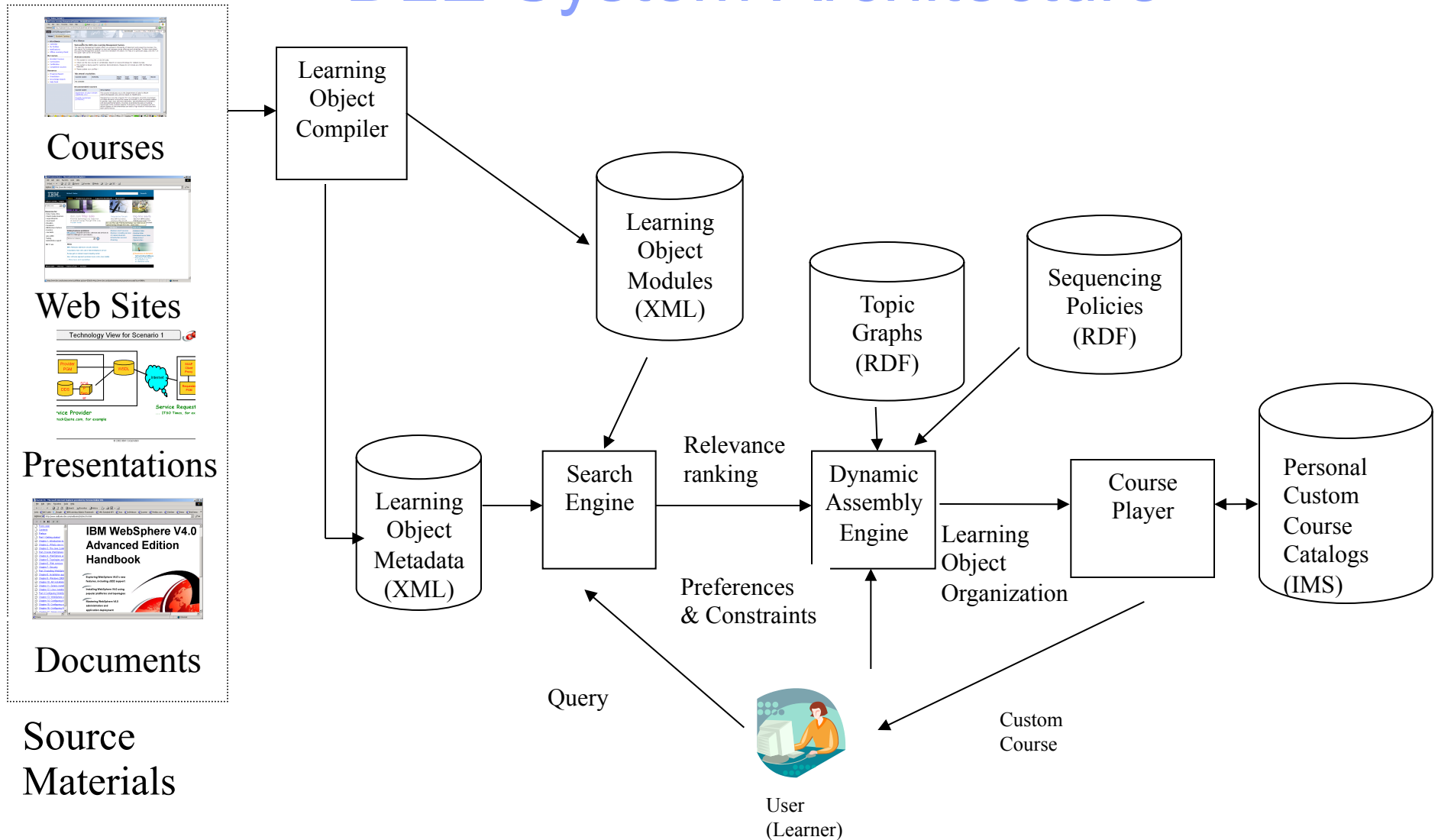
**topic:** “wsdl”

**depth:** overview

**duration:** 30-60 min.

- Output:  
A **coherent organization** of learning  
objects with a logical progression

# DLE System Architecture



# Example

## Search results

## Coherent Sequence of Related Results

Introduction to WSDL

Introduction to WSDL

WSDL Primer

WSDL Primer

**Service-oriented architecture**

Creating a Web service from WSDL

Creating a Web service from WSDL

Overview of Web services: WSDL

**Application Development Methodology**

**Application Development Methodology**

**Creating a Web service client**

**Service-oriented architecture**

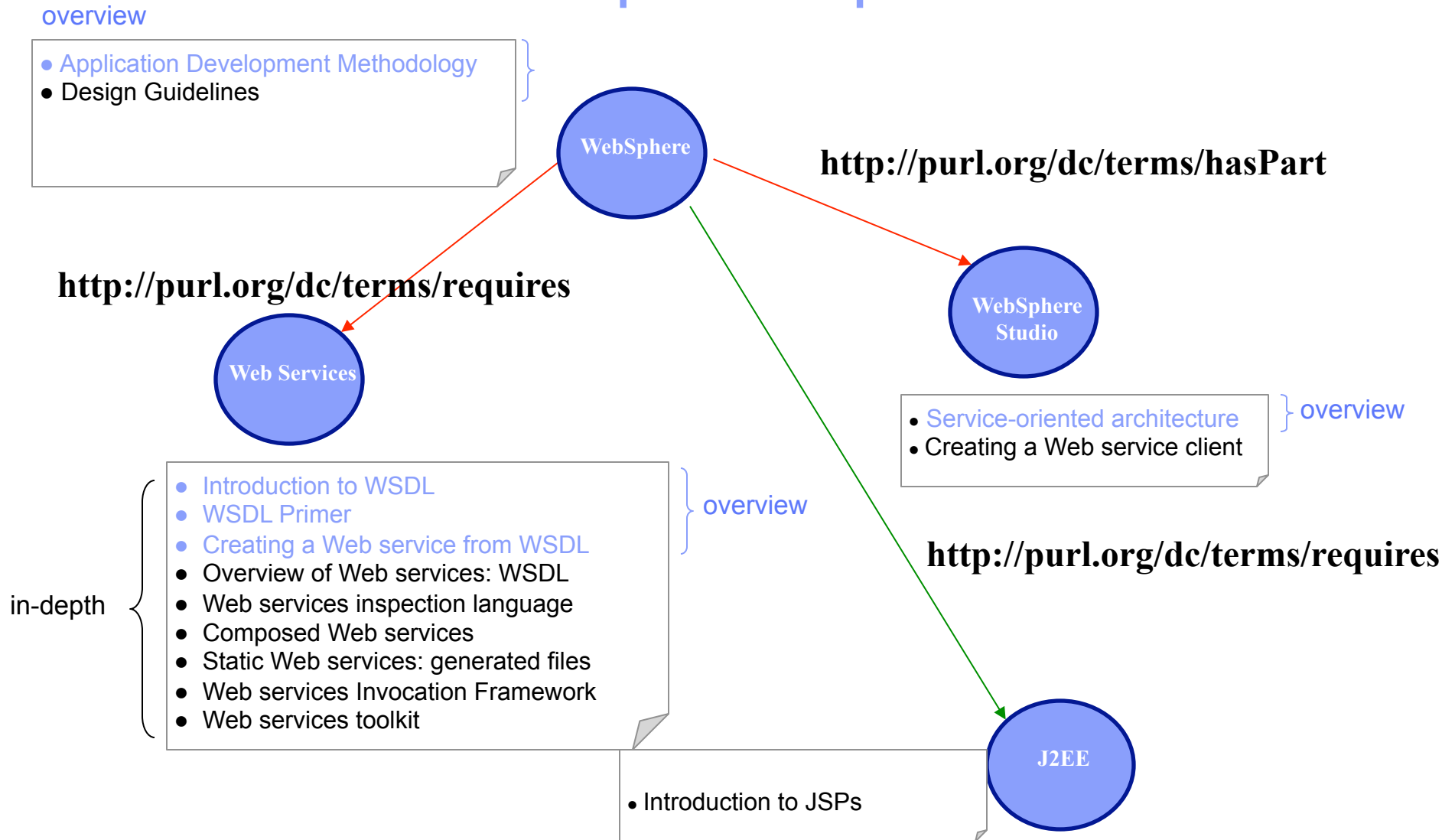
Overview of Web services: WSDL

**Creating a Web service client**

**Design Guidelines for Web services**

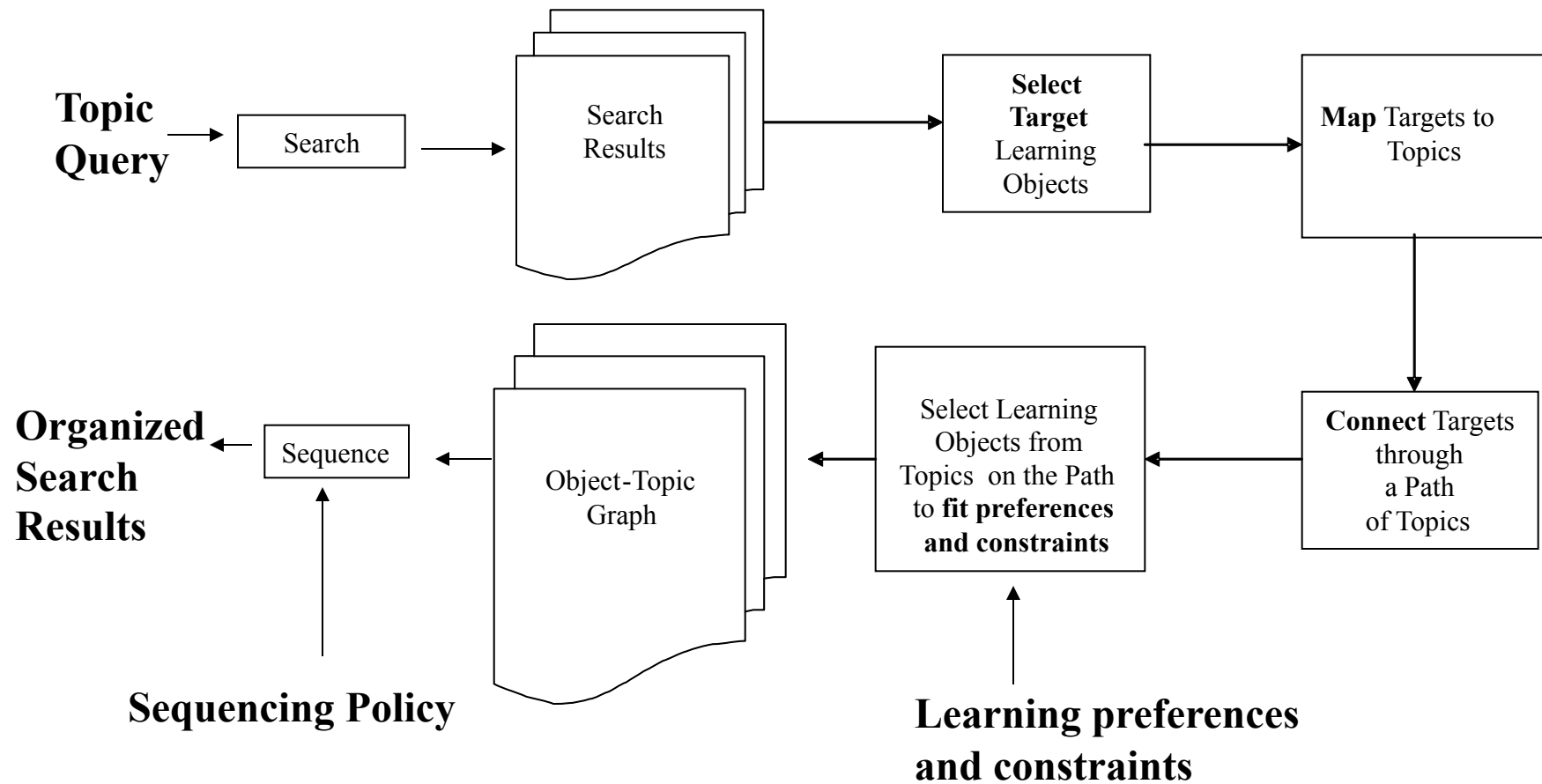
**Design Guidelines for Web services**

# Topic Graph





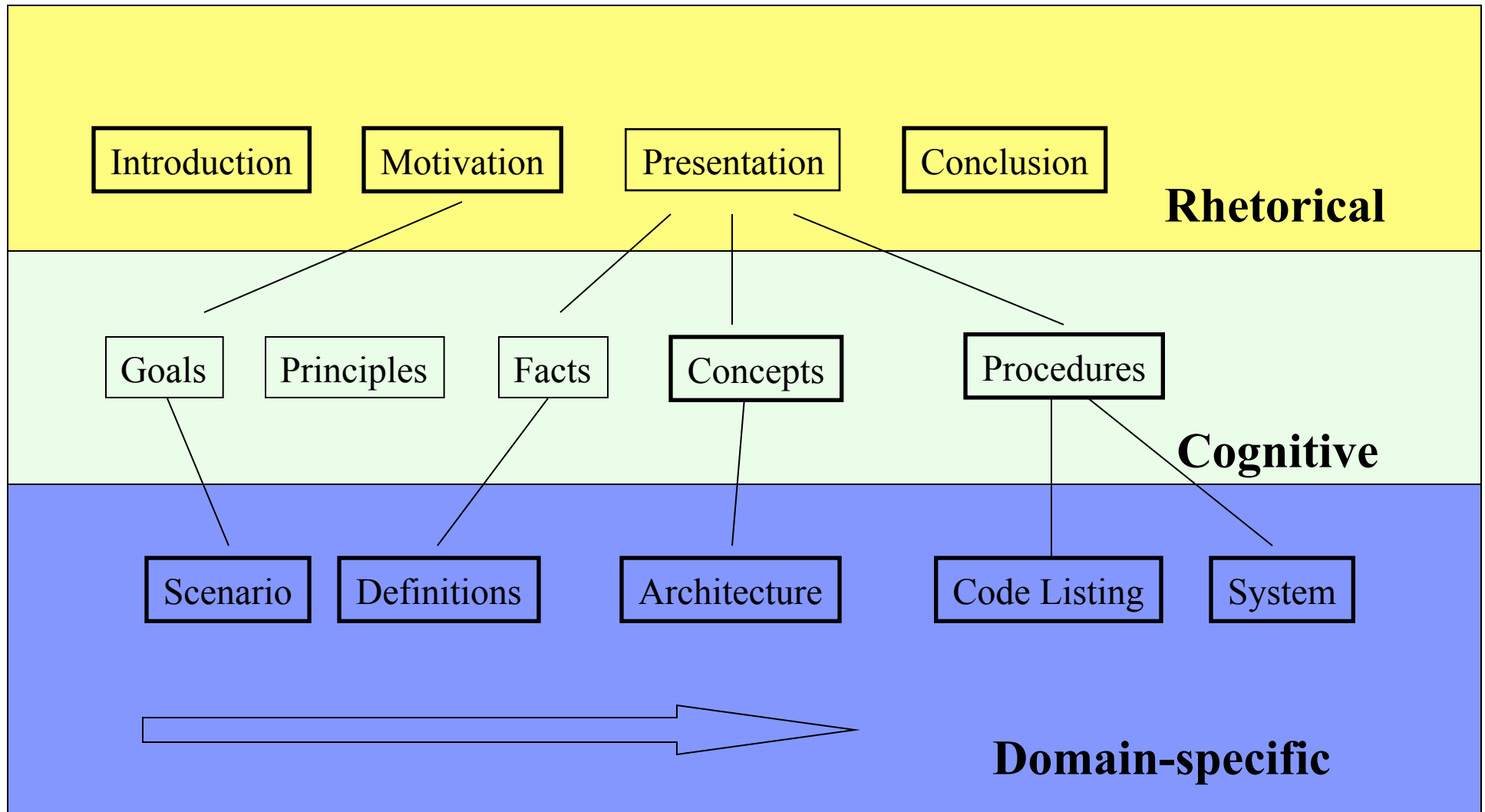
# Dynamic Assembly Algorithm



# Required Learning Object Metadata

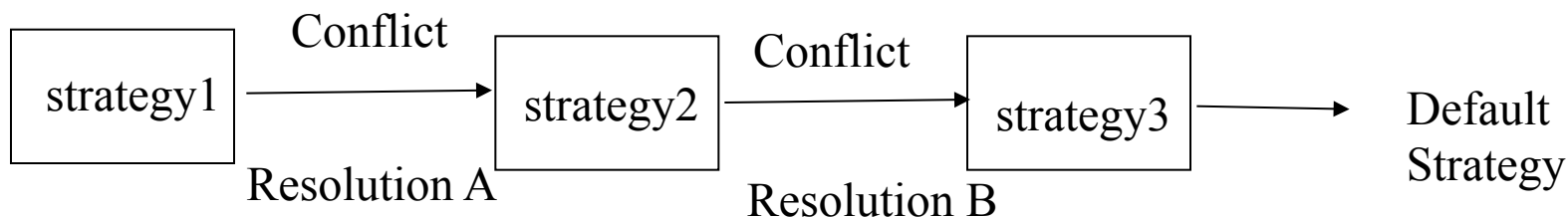
- **Topic** - *Taxon Path [9.2 Classification]* – The taxonomic path within a particular classification system. The “leaf” node in this taxonomic path is a node in the RDF graph
- **Instructional role** - *Learning Resource Type [5.2 Educational]*  
Potential roles for the learning object in future assemblies.
- **Duration** - *Typical Learning Time [5.9 Educational]* –  
Approximate or typical time it takes to work with or through the learning object

# Instructional Roles



# Sequencing Policy

- A **Sequencing Policy** is an ordered list of *Sequencing Strategies*.
- A **Sequencing Strategy** is a mechanism for ordering a collection of learning objects according to possible vocabulary for a particular metadata field.
- If a Sequencing Strategy cannot provide a total order of the learning objects, then there is a **Conflict Resolution Method**. For example, the next Sequencing Strategy in the policy could resolve the conflict. If none can resolve, there is a Default Strategy.



## Sample Sequencing Strategies

- **By Topic** – A ordering of topics in the Topic Graph.
- **By Instruction Role** – Reflecting the rhetorical structure of tutorial documents or a learning progression identified by a cognitive theory.
- **By Difficulty** – Easiest to most difficult, according to ratings.
- **By Media** – May want to list video clips before reference material.

# Dynamic Assembly vs. Search

	<u>Search</u>	<u>Dynamic Assembly</u>
<b>Query</b>	Keywords	Topic, Preferences, and Constraints
<b>Key Operation</b>	Retrieval	Crawling/Connecting
<b>Target</b>	Particular resource(s)	Collections (Web graphs, Courses)
<b>Key Metric</b>	Relevance	Coherence
<b>Benefit</b>	Finding information	Comprehension and Knowledge Integration



# Pilot Studies and Evaluation

# Pilot Studies

<u>Domain</u>	<u>Authors</u>	<u>Users</u>	<u>Date</u>	<u>Feature</u>	<u># of objects</u>
<b>WebSphere</b>	Technical Publications Department	Software Integrators	3/2003	Learner-driven Assembly	400
<b>Web Services</b>	Subject Matter Experts	Consultants	8-10/2003	Dynamic Assembly + Sharing	500+
<b>Portal Server</b>	Course Developers	Business partners	3-9/2004	Recommen dation	250+

# Survey Results

- *Satisfaction - 81%*

Users like the concept of on-demand custom courses.

- *Ease of Use - 92%*

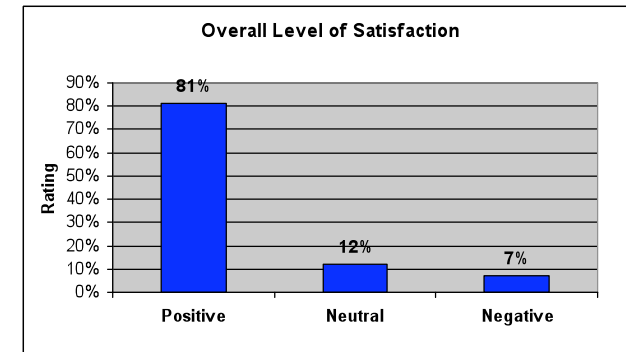
A few users found custom courses were choppy and did not flow well.

- *Enhances knowledge or skills - 81%.*

Some frustration with the limited scope of Redbooks in the trial.

- *Prefer this method of learning – 52%*

People new to this subject commented it would be impossible learn without access to an instructor



# Lab Experiment: Search vs. Assembly

Query Only group vs. a Course Assembly group (randomized, 3 expert judges of performance on a 35 minute design task after 55 minutes of using the system)

- Normalizing for years of experience, the Course Assembly group **performed significantly better on the design task.**
- The Custom Course system was able to **adapt to user's unique needs**  
*No learning object was used by every subject, 29 learning objects were used by only one subject*
- The Course Assembly group spent **more time learning** and less (frustrating) time searching  
Query group issued more queries (2-12 queries, avg. 4) than the Assembly group (1-5 queries, avg. 2). The Query spent a shorter time on a large number of learning objects, while the Course Assembly group spent longer amounts of time on fewer learning objects (reading for comprehension).
- The Course Assembly group created more detailed design solutions than the Query group  
*The total words for the Course Assembly group averaged 247 versus 128 for the Query group.*

# Learning Content Development for DLE

# Learning Content Development Roles

- Metadata Tagger

Understands source material (author/expert)  
Modularizes content, fills in metadata.



- Experience Designer

Understands the desired learning experiences.  
Defines topic relationships and sequencing policy.  
Tests DLE repository against anticipated learning needs.



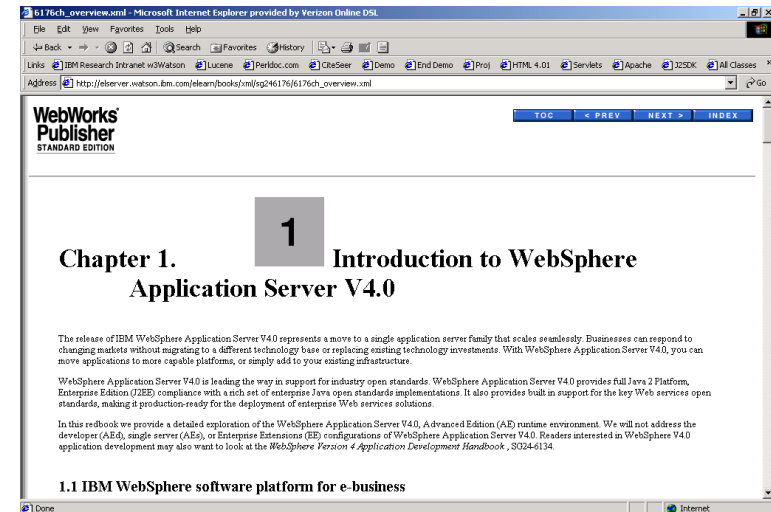


## Example: IBM Redbooks

- 16 large IBM Redbooks
- A series of “how-to manuals”
- Focused on the Information Technology topics
- Over 5,000 pages of text and graphics
- 300,000 lines of text + 6,000 images
- Consistent presentation and writing style
- No digital rights issues

### Challenges:

- Multiple templates
- Logical chunks vary in size
- Dependencies/links
- Redundancies, coverage gaps



<http://www.redbooks.ibm.com>

# Pilot 2 – Redbooks – Metadata Tagging

	B	C	D	E	F	G	H
	Title	Type	Primary Intended Use	Secondary Intended Use	Primary Audience	Secondary Audience	Primary Objective
1	SG24-6591 Patterns: Self-Service Application Solutions Using WebSphere V5.0						
2							
42	4.1.3 IBM WebSphere Application Server Network Deployment V5.0						
43	4.1.4 IBM WebSphere Application Server Enterprise V5.0						
44	4.2 IBM CICS						
45	4.2.1 IBM CICS Transaction Server						
46	4.2.2 CICS Transaction Gateway						
47	4.3 IBM WebSphere MQ						
48	4.4 Product mappings for Stand-Alone Single Channel						
49	4.5 Product mappings for Directly Integrated Single Channel						
50	Part 2. Guidelines						
51	Chapter 5. Technology options	Module	Architecture	Concepts	IT Architect	Web Specialist	Understand web technology components and how they compose a solution as part of a standard web offering.
52	5.1 Web client	Resource	Architecture	Architecture	IT Architect	Web Specialist	

- Locations (named anchors) are the finest level of modularization.
- XML content can be *included* or *excluded*
- 3 mandatory LOM fields and 8 optional
- 1 hr/100 pp. (5 to 10 hr/book)

# Example: Course Material (Presentations)

	B	C	D	E	G	H
	Title	Type	Topic	Primary Intended Use	Difficulty	Primary Objective
1						
2						
4	Linux: The Game Changer	Module	Web browser	Concepts	difficult	Define the Linux model and its value in today's business environment
5	The conventional model for software development -- the game that's been played for so long in the industry -- is for a company to try to satisfy a market need with a proprietary product.	Exclude				
6	Linux Defined	Resource				
7	Linux is a radical departure from the old model.	Resource				
8	Established and Growing	Module				
9	That appeal is evident in the fact that shipments of servers running Linux have been growing at a faster rate than any other a compound annual growth rate of 35 percent according to IDC.	Resource				
10	Linux Value	Resource				
11	What's propelling Linux' growth?					
12	How Customers are Using Linux					
13	Customers are deploying Linux essentially in five different ways:					
14	Linux in the Marketplace					
15	These customers are creating a broad-based market for the open-source operating system.					
16	IBM's Linux Strategy					
17	IBM has conceived a three-pronged strategy to capitalize on the growing popularity of Linux and change the game:					
18	IBM's Commitment to Linux Technology					
19	Our strategy has spawned a firm commitment to supporting Linux technology and the open source community with personnel and resources.					
20	IBM's Linux Portfolio					
	This commitment to changing the software name					
	Metadata Input					

- Embedded authoring into presentation tool

- Course developers can quickly convert an existing student guides with notes

- Single slides, notes, or groups of a few (2-10) of these objects become modules.

- Units are broken down to supporting objectives.

- 1 hr/unit (~10 hr/course)

# Simple Content XML wrapper for Composing embedded objects and XML fragments

`<module>`

`<chapter ....>`

`<sect1 ....>`

XML Fragments

`<html:object src="/content.htm">`

alternate text

`</html:object>`

Embedded object

`<indextext>`

text equivalent of embedded object

`</indextext>`

Indexable text (not rendered)

`</module>`

## Conclusions

- Dynamic Assembly is a new approach to “just-in-time” learning that utilizes IEEE LOM, IMS Content Packaging, and RDF Topic Graphs.
- IBM Dynamic Learning Experience (DLE) integrates search, assembly, sequencing, customization, archiving, and sharing.
- More research is needed to determine how to develop topic graphs and sequencing policies for learning object repositories supporting Dynamic Assembly.

# Thank You!

<http://www.alphaworks.ibm.com/tech/dle>